

Master Thesis

Automation of a workstation for ultrafast lasers: requirements, solutions and development of a pickup tool



Figure 1. Ultrafast lasers free space modules containing optical components

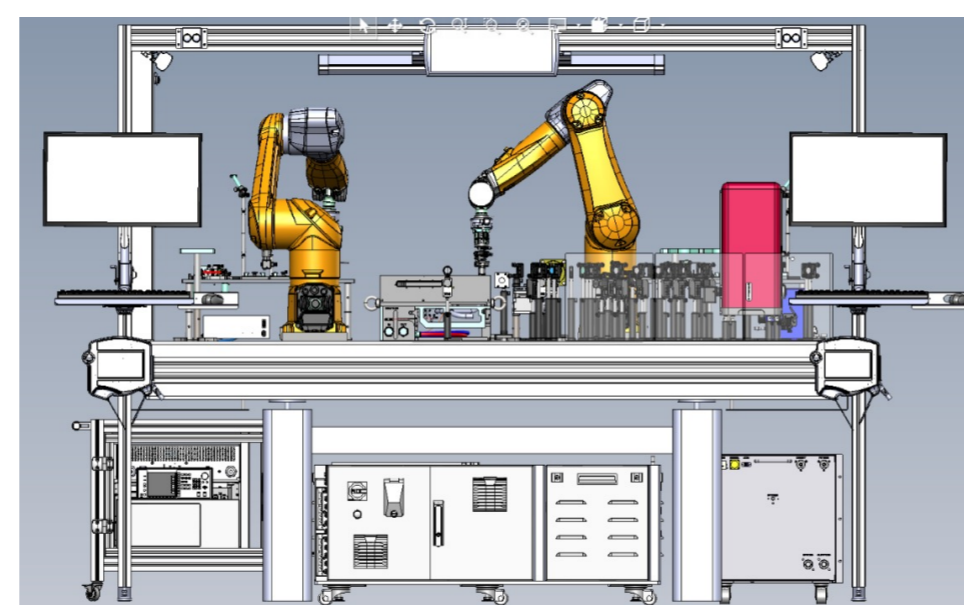


Figure 2. Automated workstation for the free space assembly

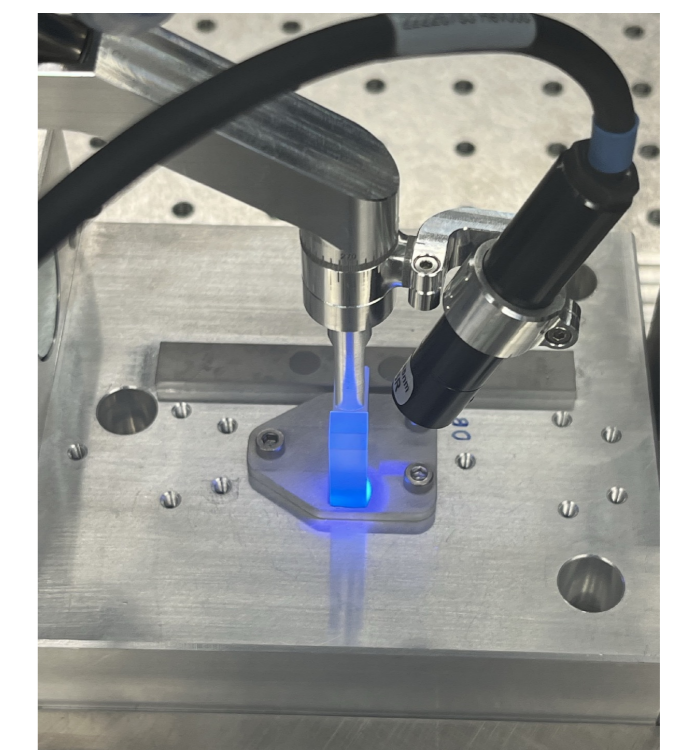
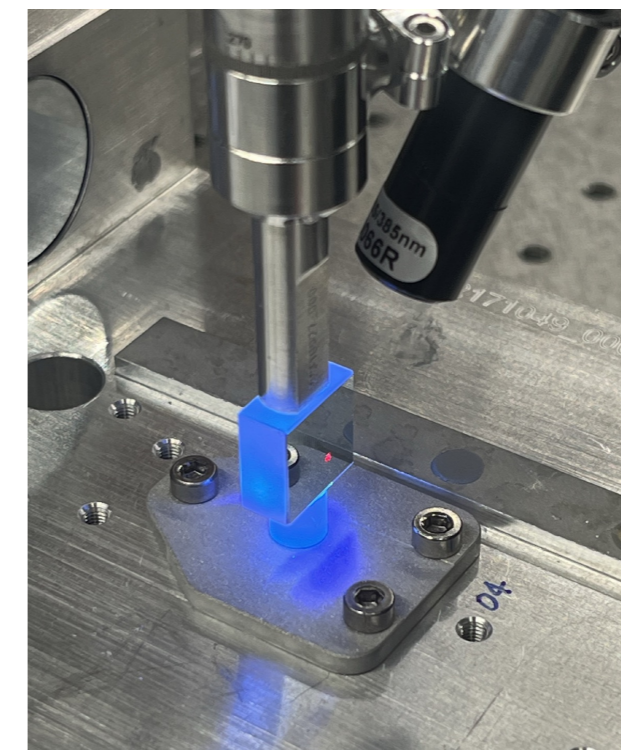


Figure 6. Gluing validation for a tower mount (left) and side mount (right) optical components

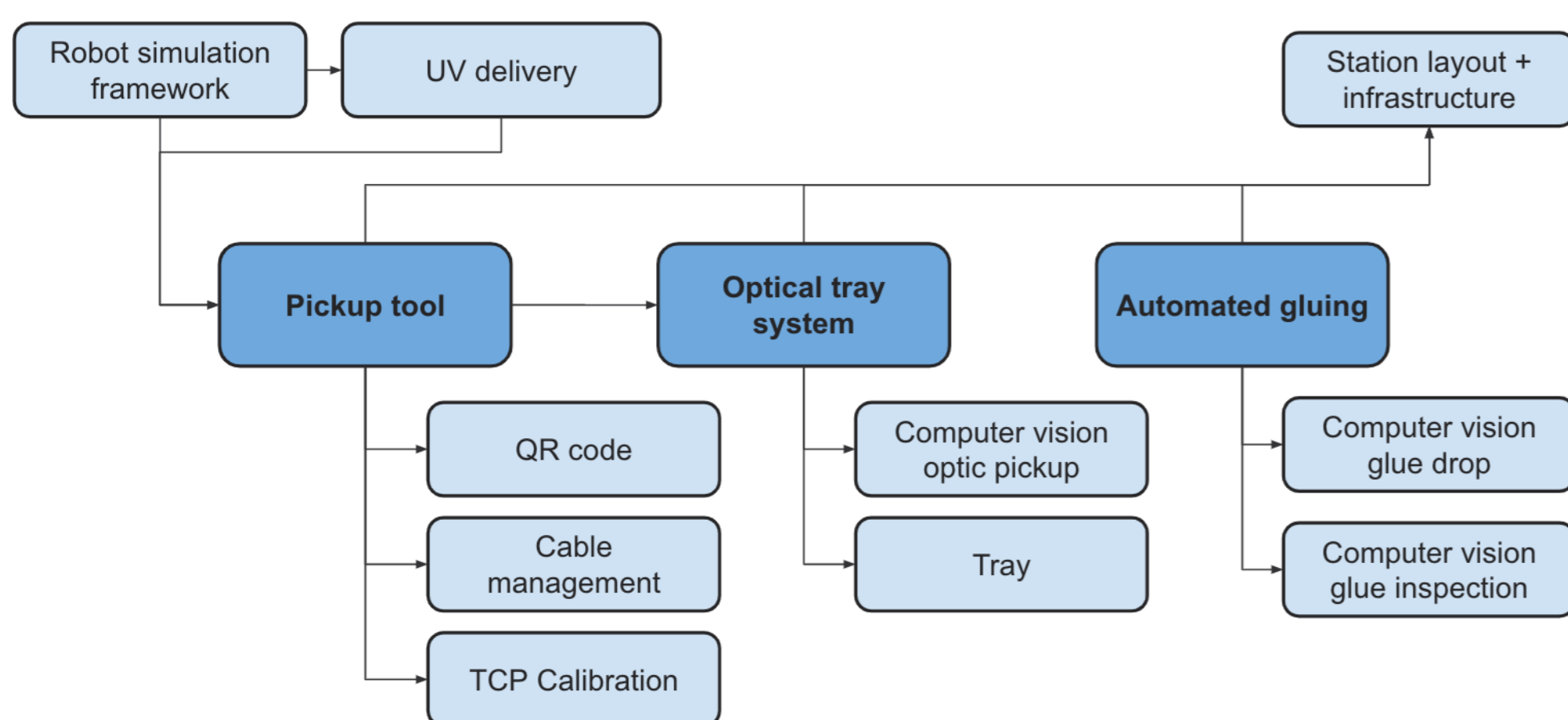


Figure 3. Modules for the second generation of automated workstation

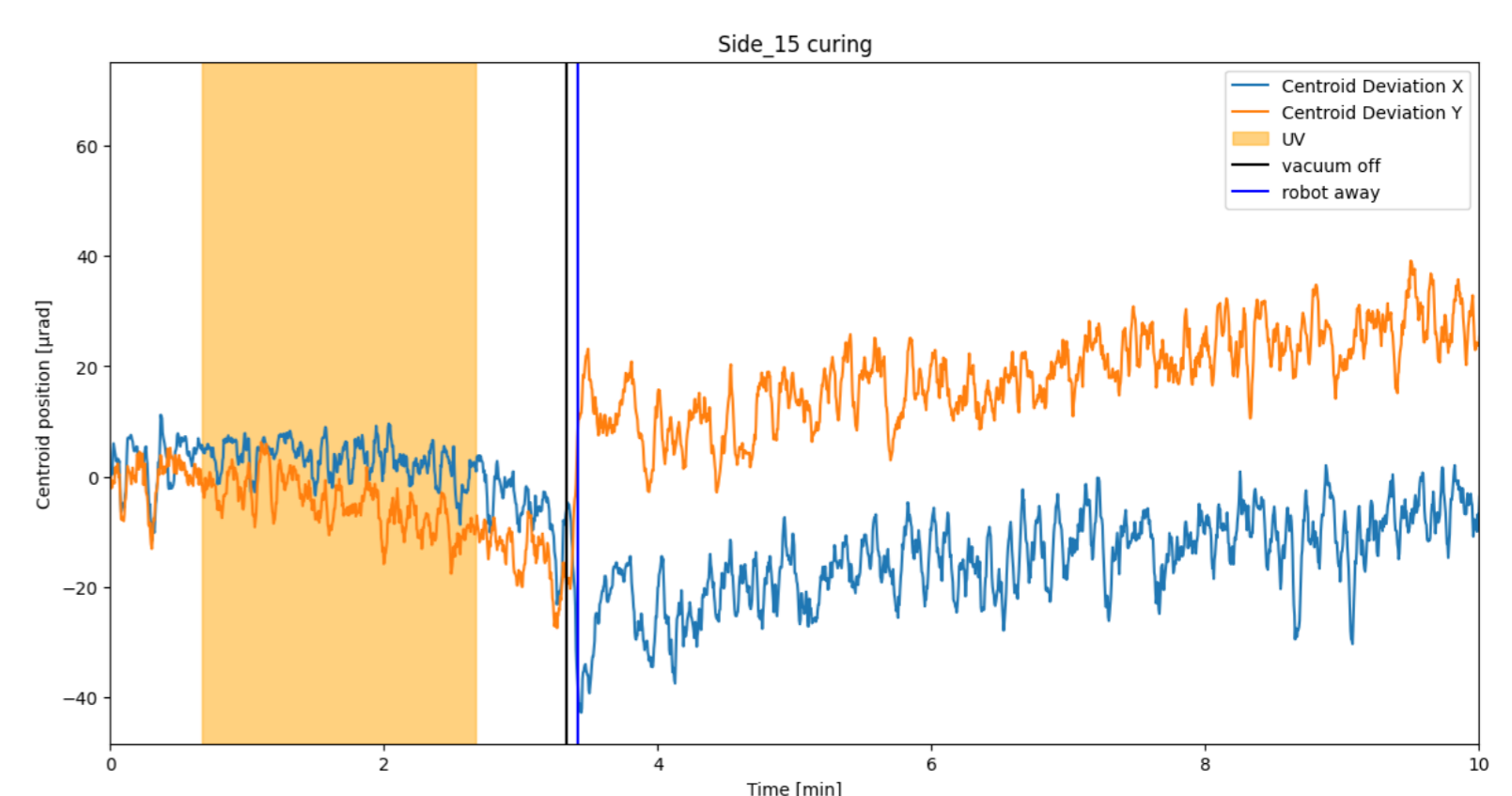


Figure 7. Sample example of optical motion during curing (side mount)

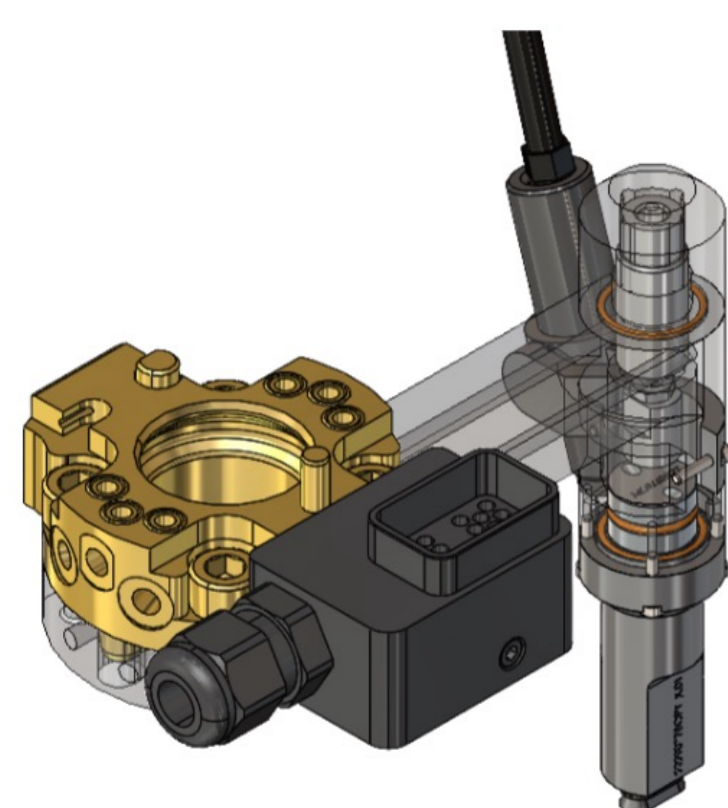


Figure 4. Transparent view of the retractable pickup tool

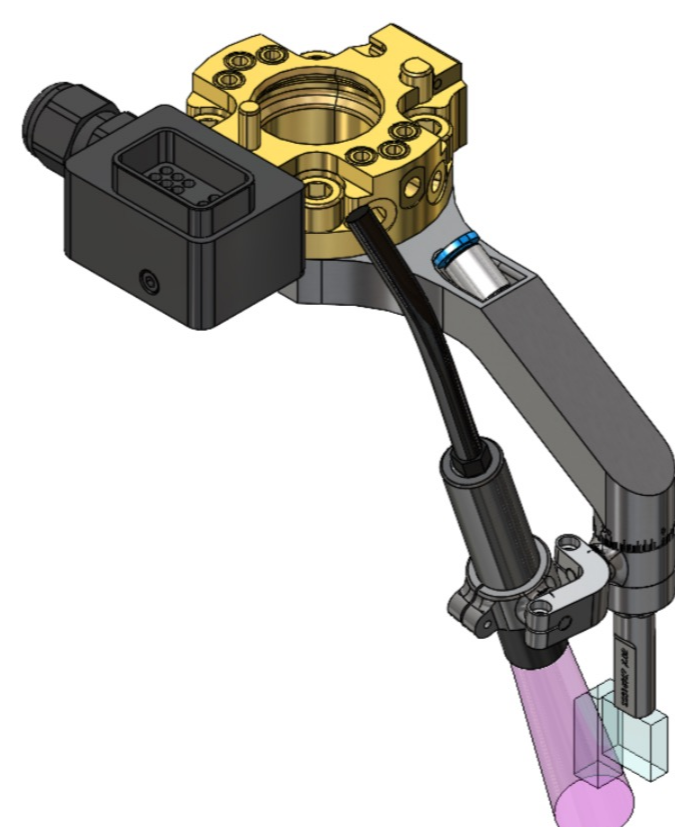


Figure 5. New pickup tool with "Slim tip" at Yaw 90°

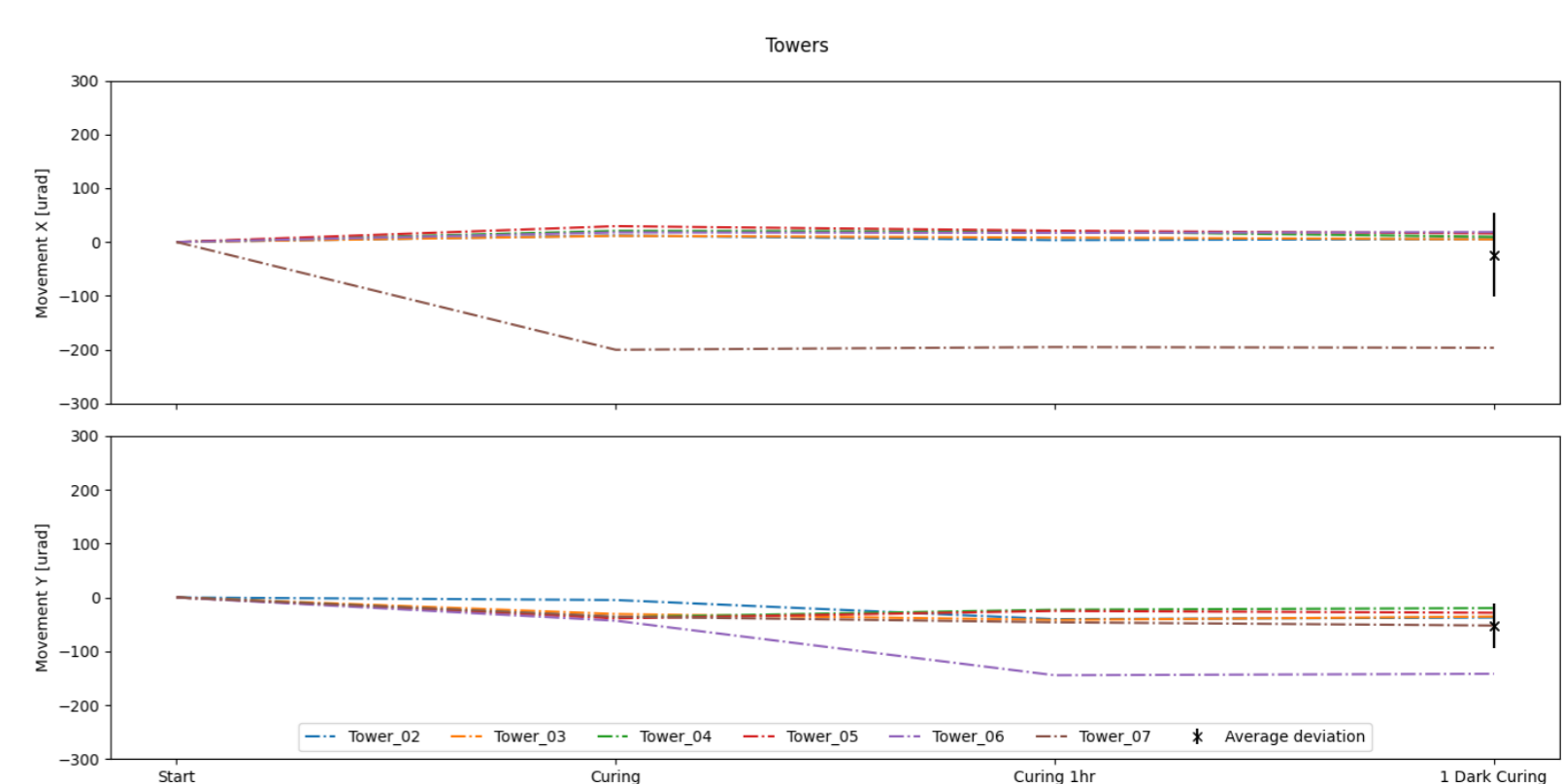


Figure 8. Optical motion during the curing of the six samples (tower mount)

Problem definition

- Challenges in automating precise assembly of optical components in the free space modules (Figures 1 & 2).
- Existing workstations have large footprint, and general-purpose tools that lead to collisions and need for manual processes.
- Current systems have inefficiencies and human error.
- Need for a compact, flexible, and fully automated solution.

Proposed solution

- Develop a second-generation automated workstation.
- Enhance productivity, quality, and efficiency in laser manufacturing.
- Reduce station footprint, human error, lower costs, and improve cycle times.
- Develop modular pickup tools, redesigned optical tray system, and automated gluing process using robot arms (Figure 3).
- Focus on modular pickup tool with interchangeable tips and UV lamp integration (Figures 4 & 5).

Findings

- Modular pickup tool successfully developed.
- Improved efficiency and accuracy in assembly with the developed pickup tool, including curing (Figures 6 to 8).
- Successful automation of the free space module in ultrafast lasers.
- Initial tests of the new optical tray system and the automatic gluing device are promising.
- Significant contributions towards more advanced laser workstations.

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